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EDITORIAL

Maintenance of Cattle Fodder. The unavoidable restriction in the number of railway wagons (for carriage of goods by railway) and the rationing of petrol as well as the requisition of automobile lorries for war purposes have thrown the burden of transport on the time honoured bullock carts. That brings us to the question of the proper maintenance of the cattle, the beasts of burden, who are not given the attention they deserve. India's possession in this respect is one, the like of which is rarely met with anywhere else in the world. The problem is now to provide proper and enough fodder for these millions of cattle throughout the year. The fodder problem is felt most keenly in the dryland areas. In these tracts the fodder *par excellence* are the millets—sorghum and *ragi*. In fact sorghum appears as though it would come to occupy the most important place amongst the fodders of the world. It is now grown extensively in the whole of the tropical and sub-tropical countries of the world. Trials are being conducted in Italy, Germany, Russia and other temperate countries to evolve suitable strains of sorghum to be grown as fodder. It is a plant which is better able to stand drought than maize and bulk for bulk gives a higher yield of straw. *Ragi* though an equally good one is not so cosmopolitan as sorghum. As a dryland crop it is confined mostly to the cooler plateaus. Here it is valued higher than the sorghum straw as being more nutritious. Whereas sorghum is fed both green and as straw, *ragi* is preferred more for silage, and as straw it is used only in Mysore. *Cumbu* the other dryland crop has not so much value as fodder. These crops are sown primarily for grain, and fodder is only an unavoidable bye-product. Scarcity of fodder often arises owing to the failure of rains, and secondly a fodder crop as such is not usually raised. It is often complained that the Indian farmer sells out his stock of fodder without any concern for his cattle, and that 75% of the cattle in India are starving. The remedy for this evil lies firstly in preventing the *ryot* from selling his stock of fodder and secondly by supplementing the available stock where facilities exist as in the wetland areas by raising fodder crops, especially sorghum. A *ryot* does not ordinarily sell out his fodder stock unless he is forced to do so by circumstances. The forests of India contain numerous varieties of grasses that could be used as fodder, but which are now not being put into full use. These could be cut at the proper time, dried and converted into hay. This would thus give a supplementary fodder though it may not be as good as *cholam* or *ragi*. These may be stored at convenient centres and sold according to demand. The

extra stock of fodder means money to the *ryot* Unless he is able to supplement the income he gets from the sale of his main produce, the grain, by subsidiary income from dairy sales, etc., he will not be able to meet his demands. A well organised dairy industry has not yet been established in India. In all the big towns milch and draft cattle are still being kept inside the municipal limits. These depend for their fodder almost entirely on those stocked by the *ryot*. Round these towns of course, an industry has developed in growing green fodder such as guinea grass, lucerne, etc. but the bulk feed has to be met with by the dry fodder stocked by the *ryot*. It is but natural that the *ryot* tries to sell out all his extra stock when there is a good demand. The trouble arises when his next crop fails. Many methods are suggested to improve the financial condition of the farmer, but most of them take him into paths rather unfamiliar to him. Poultry and dairy farming are the two which are most familiar to him ever since his childhood. If conditions are improved in the method of marketing of these two produces, it would go a long way to help him. A farmer is never slow to respond to methods which are profitable to him, but first he must be convinced of their usefulness. Such of the rural areas as are within easy reach of towns have developed these two industries with profits. But a large tract which is beyond the reach of towns needs an organization preferably, a cooperative one, which should connect up the rural with the urban centres. Milk as such may not be transportable but ghee certainly could be easily transported. One clarifying centre situated at a central place could collect from 4-5 villages around. The butter could be clarified there and sent to a bigger depot whence it would reach the consuming public. This would ensure a steady and trustworthy market for the farmer and at the same time prevent much of adulteration and defrauding the buyer. With such encouragement the farmer would be tempted to keep his livestock in better condition and stop selling the fodder. Further he would get more manure for his fields and have an occupation for his spare time.

If enthusiastic persons trained in dairying and poultry keeping work in rural areas they would serve to disseminate sanitary and progressive ideas to the farmer. Should such an organization be successfully established, ghee which is very necessary to the diet of the Indian populace would be cheap enough to be within the reach of the poorest and drive away from our midst imitations, such as vegetable ghee, etc, which lack nutritive and vitamin values.

Adviser to H. E. the Governor of Madras We have great pleasure to learn that S. V. Ramamurti, Esquire, I. C. S. has been appointed as Adviser to H. E. The Governor of Madras, in place of Sir H. M. Hood who has proceeded on leave. He is the first Indian who has been chosen to fill up the important post of an Adviser. Mr. Ramamurti is no stranger to us. As Secretary, Development Department and later as Director of Agriculture, Madras, he has been in close contact with the progress of agriculture in the Province. On behalf of the Madras Agricultural Students' Union we convey our hearty congratulations.

Cultivation and Marketing of Papaya in the West Godavari District.

By A. SANKARAM, B.Sc. (Ag)

Introduction. The papaya is one of the quick growing and early yielding fruit crops. Its cultivation at the present day is of importance, as a rapid increase in the production of quick growing fruits is incumbent on the nation. In the presidency of Madras, it has not been very popular to the extent it deserves, in spite of the existing possibilities for the same. This is partly due to want of adequate knowledge of its cultural details among the cultivators, and the scant demand for the fruit as a major part of the public are unaware of its nutritional value and dietetic importance. As a health-food the papaya has few equals and should therefore receive wider recognition in a country with immense possibilities for its successful culture. Besides its fruit value, the papain which it yields is much valued in medicine, in the preparation of special foods and in various other commercial businesses.

The original home of papaya is said to be West Indies, the shores of the Gulf of Mexico and perhaps Brazil. It is said to be indigenous to Tropical America but its exact origin is yet unknown. In Tanuku Taluk (West Godavari District) of this Presidency, the fruit is grown in recent years, to the extent of 20 acres. The area under this fruit crop is steadily increasing owing to the growing interest in its culture among the farmers of the area. In the present paper the details of cultivation as practised in and around Tanuku are presented and the stages at which it needs improvement are indicated. The method of extraction of papain, which is not practised at present for want of practical knowledge of the same, is embodied in this paper with the hope that it may receive wide recognition among the enterprising growers of this fruit. In this country the fruit is successfully grown in Bombay, Bengal, Bihar and the United Provinces. Its cultivation is also known in Assam, Orissa and many other parts of India.

Climate and soil. Its supposed origin in the tropics is indicative of its heat-loving nature. Intensive cold weather and heavy frost are definite set-backs for fruit development. It thrives well from sea level up to 3,000 ft. Strong windy areas are adverse to the growing of this fruit, as such winds carrying sand and grit may scrach the tender skin of the fruits causing exudation of the milky juice. This not only renders the marketing of the fruit difficult but also impairs its keeping qualities. Best results are always obtained on soils of high fertility and good drainage. With the supplementing of good manure the fruit can be raised even on poor soils. In Tanuku taluk bumper crops are seen in the garden lands where the soil is a rich sandy loam admitting free drainage. Deep soils with high clay content are definitely unsuitable.

Seed and Selection. In nature papaya is cross pollinated except in hermaphrodite plants, where self pollination seems to take place. Owing

to cross pollination the progeny usually exhibits wide variability even between plants raised from the seed of the same tree. It is therefore of very great importance for the grower to obtain his seed from a reliable source, where selection of seeds from inbred strains has been in operation to ensure uniformity with respect to quality, shape and size of fruit, etc.

Propagation. The most common method of propagation is by seeds obtained from matured fruits. The plant can also be propagated vegetatively by cuttings but its adoption is uncommon on account of practical disabilities and uneconomic character.

Nursery. Seeds are sown in specially prepared nursery beds. The seed bed is brought to fine tilth after ploughing six to eight times. About half a cart load of well rotten cattle manure is applied to the plot to raise vigorous and healthy seedlings. The seed beds are finally levelled and seeds are sown during the first week of June. The sown bed is lightly covered with soil and next day early in the morning a light irrigation is given. The seed beds are pot watered every day during the first week and on alternate days during the subsequent weeks. Later the beds receive watering as and when found necessary. About ½ lb. of seed sown in a plot of 30′ x 6′ can be relied upon to give sufficient plants to plant an acre About 8,000 seeds go to make a pound. In cases of heavy rain or severe sun the beds are protected with thatches. After a week the seeds begin to germinate and the planting material will be ready in four to five weeks from the date of sowing the seeds, when they attain a good growth of 9″ to 12″ from the ground. The seedlings are planted in the main field 8′ apart on the square and the number of seedlings required is 680 per acre. Two or three seedlings are generally planted at each spot and thus the seedling requirements will be 1,400 to 2,000. A pound of good seed costs from Rs. 1—8 – 0 to 2.

In Ceylon, where the cultivation of this fruit is very common, plants are raised in baskets. In each basket filled with soil 4 to 5 seeds are sown, the number of baskets depends upon the number of planting holes per acre in the main field. Each basket is planted out when the plants are about 3 to 4″ high. This method is reported to give very good results and it deserves a trial here also.

Preparatory Tillage. The preparatory tillage of the main field commences in the month of May, soon after some showers are received. About eight ploughings are given to bring the land to fine tilth. The fields are ready in July and planting commences by the end of this month.

Manures and Manuring. Along with ploughing cattle penning is commonly resorted to in the main field. This is supplemented by a basket of well rotten farm yard manure at each planting spot, applied a month after transplanting the seedlings. This is all the manure that the crop receives during the first year. In the second year the same dose is repeated only in case it is available. But as the crop responds to heavy manuring it will be profitable to apply ½ lb. of bone meal, 1 lb. of castor cake and a basket of cattle manure and ashes to each plant every year.

Transplanting and Thinning. Transplanting is done in the well prepared main field towards the end of July. The seedlings are transplanted in planting holes 2′ × 2′ × 2′ previously dug out for the purpose, as is common in other areas where the fruit is grown on a large scale. The planting spot is stirred with a hand hoe before planting. The nursery beds are previously pot watered to facilitate their lifting. Transplanting is generally done on a wet or dull weather towards the evening. Before and after transplanting pot watering is done. 3 to 4 seedlings are planted at each planting spot and the young plants are shaded until they are well established. After a month, when the plants attain a good size, the vigorous growing one is retained and the rest are thinned out. The growers have no knowledge of the importance of sex in thinning and the vigour of the plant is the only chief consideration for retention or otherwise. It is advisable that growers should be in a position to distinguish the sex as soon as the plants begin to flower, so as to retain only one male plant for every 30 to 35 female plants, pulling out the rest of the males. This ratio of males to females is adequate to provide enough pollen. In the absence of correct knowledge of sex the excess of male plants will only be a burden to the garden as their place can better be occupied by fruit-yielding female plants. Strict observance of this would go a long way in increasing the net profits of the growers.

* **Experiments—Sex in Papaya.** The fact that the sex forms are identical in general appearance, excepting for the flower and fruit characteristics makes their distinction impossible in the early stages. At the Fruit Research Station, Koduru (Cuddapah District) experiments were conducted to test the efficacy of certain existing notions in the determination of sex in papaya in the nursery stages. The trials with the metal indicator could not furnish an efficient means for the purpose. Studies to associate sex with the morphological characteristics of the roots during the seedling stage was found to be neither sound nor a feasible practice. The common belief that some relationship exists between the sex and the position of the seed in the fruit was experimented upon, but the results were not conclusive. Lastly heading back of the male trees soon after flowering was attempted, to see that if this treatment induces the trees to change their sex. This treatment was also found to be ineffective.

Similar to Dr. Hofmeyer's experiments, on the continued inter-crossing of plants raised from the seed from the same tree, to see if some uniform types of the fruit in respect of quality, size, shape, etc., can be obtained, are under trial at the Fruit Research Station, Koduru.

Irrigation. Pot watering is only resorted to during the growing of the plants in the nursery and later till about a week when the plants get well established. During the next week the plants are pot watered on alternate days and afterwards regular irrigation commences. Well irrigation drawn by a mhote is the usual practice. Under conditions obtaining in West

* Madras Agricultural Stations Reports 1936-37, 1937-38 and 1938-39.

Godavari in all 15 waterings, besides the normal rainfall, are necessary in a year (August—July) to get at good results. Watering is generally done once in ten days according to soil and weather conditions. In years of low rainfall even twenty waterings are necessary to keep the crop in good yielding condition. Though the crop responds fairly well to liberal watering drainage is of paramount importance as the plant is very sensitive to water stagnation.

After Care. The garden is weeded as often as necessary and thus clean cultivation is universally adopted by the growers. Besides, the basin beds round the plants are hoed twice during the year to keep this soil loose for the irrigation water to percolate easily and at the same time to maintain retentivity of the same. No other inter cultivation is ordinarily given.

Thinning of Fruits. In the pure female plants (dioecious pistillate flowers are borne on short peduncles in the axils of leaves. The number of flowers on each peduncle varies from 3 to 4, the terminal one being the largest and the oldest. Normally only this develops and the others drop off. Yet it is not uncommon to find two or more developing in one axil of the leaf leading to over crowding of fruits in the limited space. In the early stages when the plant is making vigorous growth, the internodal space is moderately sufficient to accommodate all the fruits that have set in. But as the plant grows older the limited internodal space is hardly accommodative for each fruit to develop to its normal size. As a result of this, normal development of all the fruits is prevented resulting in small compressed fruits of little value. Thinning becomes one of the important operations and this can best be done when the fruits are young and small. This is not practised locally as growers are under the wrong impression that their fruit yield will be reduced. They are only guided by the number of fruits harvested and not by the size, uniformity and weight of the individual fruits that fetch better price. It is always economical from many points of view to thin out the excess of fruits and to allow only one fruit per leaf axil to reap bumper harvests.

Harvest and Yield. The plant begins to flower by the end of November, i.e., 4½ to 5 months from the date of transplanting under the conditions obtaining in the district. Fruit setting commences 1 to 1½ months later. It takes nearly two months to develop and attain maturity. Thus the actual harvest of the fruit commences after nine to ten months from the time the plants are set in the garden The yields are low during the months of April and May, harvest being done once a week. With the advance of age of the plants the yield increases and it reaches a peak during the period of August to November, necessitating harvest even on alternate days During the first year the tree will not attain a height of more than 8′ to 10 enabling easy harvest of the fruits. Well developed fruits are carefully plucked out from the tree. The maturity is reached with the development of a light yellowish colour admixed with green. On pressing the skin of the fruit with the thumb a light impression should be left on the fruit. The fruit

will be ready for the table after 3 or 4 days. Fruits can as well be allowed to ripen on the plant itself but the damage from crows disallows this practice.

The yields are very varying from plant to plant depending on a variety of conditions. In the first year of its fruiting each tree on an average gives 40 fruits. Taking 600 plants to be fruiting in the garden (average for the area) nearly 24,000 fruits weighing about 72,000 lb. can be obtained from an acre and this is an average yield. Under favourable growing conditions brought about by such factors as liberal irrigation during summer months, judicious manuring and clean cultivation the plants will continue to give the same yield, in the second fruiting season also. But under neglected conditions 18 to 20 thousand fruits can be expected.

Age of Gardens. This fruit crop is a short duration one and does not last long. The period of economic productivity is not more than three years. In this area the gardens are retained only up to a total period of nearly three years, during which two crops are harvested. Though the plants bear fruits even after this period for another couple of years the size of the fruit as well as the yield becomes considerably small. Further the trees grow to a height of over 20′ and harvest becomes very difficult. It appears to be economical to have a new plantation altogether after a period of three years from the date of planting. In the Bombay Presidency the old plantations are renewed by heading back the old trees, when small branches are given out at a height of 6′ from the ground. The branches bear fruit in the usual way and satisfactory results were obtained at Modibag* of the Bombay Presidency.

Inter Cropping. It is a common practice in the area to raise low growing crops like chillies, onions, tomatoes, etc., in gardens where papaya is the main crop. This can only be practised for a period of about eight months when the trees grow bigger rendering the interspace unfit for the purpose. The papaya itself is raised as an inter crop in mango and citrus gardens provided irrigation facilities are satisfactory.

Pests and Diseases. In the West Godavari District there cannot be a better example of a fruit crop than the papaya which is almost free of insect pests and fungoid diseases. Even foot rot has never made its appearance in the gardens of the area.

Quality and Varieties. The quality varies with the variety of the fruit. The oblong Washington and the round Gujerat are the common varieties grown locally. Of these two the Washington is more popular being free from the characteristic flavour which is not tolerated by some. One or two non-descript varieties also exist in the area but they are regarded as inferior.

* Bulletin No. 162 of 1930 "Papaya cultivation in the Bombay Presidency (excluding Sind) By G. S. Cheema and P. G. Dani of the Department of Agriculture, Bombay."

Nutritive Value. The papaya is a highly nutritious and most delicious fruit and is a cheap source of vitamins A and C. Dr. Aykroyd in *Health Bulletin* No. 23, published by the Government of India, gives the composition of the ripe fruit as below.

Moisture	89·6 %	Phosphorus	0·01 %
Protein	0·5 ,,	Iron (mg.)	0·4 ,,
Fat (ether extractives)	0·0 ,,	Calorific value per 100 gms.	40·0
Mineral matter	0·4 ,,	Carotene (International vitamin A units per 100 gms)	2,020
Carbohydrate	9·5 ,,		
Calcium	0·01 ,,	Vitamin C, mgs. per 100 gms.	46

The ripe fruit is commonly used in the district at the table and the raw one as a vegetable and in the preparation of soups of the Indian diet. Besides, candied papaya is a product of pleasing taste and of high palatability. Still there are many other preparations of papaya that are of great relish to one and all. Many of these preparations can be made cheaply with no elaborate equipment.

Marketing of Fruits. The marketing season commences with May and usually extends up to November. The season of peak harvest and sales of the fruit is August to October.

Markets. At present, as the production of the fruit is very limited and is just sufficient to meet the internal demand of the district, it is not available in any large quantities for export to distant places. The fruit finds a quick sale in the markets of Tanuku, Bhimavaram, Nidadavole, Kovvur and Tadepalligudem of the West Godavari District. Fruit grown in Dharmajigudem of Chintalapudi Taluk finds a sale in the Ellore markets.

Demand. In view of the limited production the supply and demand are just counter balancing. But with increased production it must find a market outside the district. It may be pointed out here that even within the district only the educated class, who are aware of its value as a health food, consume it. A few dislike it on account of its peculiar characteristic light flavour and a major part are ignorant of its health promoting value. It is therefore necessary to educate the public on the value of the fruit to create a keen demand for it.

Prices. The prices are very variable depending on the variety, season and demand. Generally a rise in prices begins from November and this reaches a maximum in April when the fruits become rare. The prices are at their lowest during August—October. The local fruit vendors purchase gardens from the owners. The growers also sell the fruit in hundreds at the garden. The price per hundred varies from Rs. 2 to 3 depending on the uniformity of the size of the fruit, variety, season and demand in the local markets. In retail a well sized fruit of 3 lb. or more in weight of the Washington or the Gujerat variety is sold for one to one and a half annas.

Grading. No grading of the fruit is attempted by the growers but the retail fruit vendors make a rough classification only according to the size as big, medium and small.

Marketing difficulties The marketing of the papaya fruit to distant places presents certain difficulties in that it is not easily portable and requires careful handling. The losses of fruit during the transit depends on the condition (ripeness) of the fruit. Only fruits with fairly firm skin and just commencing to turn yellow should be used for sending to distant markets. Generally the fruit is carried in bamboo baskets in country carts. The fruit hardly keeps good condition for more than five days. Unless the fruit is packed with care in a soft medium, its marketable value will not be appreciable to be of any reasonable profits

Papain—Extraction and Preparation. The milky juice (latex) that exudes when the skin of a well developed fruit is lanced contains the enzyme papain. Papain, as its product is commonly termed, is similar to pepsin and has become an incalculable aid for certain digestive ailments. At the present time, Ceylon is the only country producing papain on a commercial scale.

The preparation of papain from the latex of these fruits is a simple and profitable process. The latex containing maximum papain is best obtained from well developed fruits immediately before they are ripe, by making 2 to 4 longitudinal incisions $\frac{1}{8}''$ deep and $\frac{1}{2}''$ apart. Early mornings should be preferred for this process as the flow at that time is more profuse. The juice is collected in a glass or porcelain saucer held conveniently under the lanced fruit. Lancing is best done with any sharp edged tool of bone, horn, ebonite, ivory or glass or even sharp edged piece of bamboo but iron or ordinary steel must not be used as the resulting product attains an undesirable tint. A part of the exuded juice is caught in the saucer and a part that remains coagulated on the fruit can be removed with a fine brush. The latex soon coagulates into a white curd possessing a pungent characteristic smell. Drying must be effected as speedily as possible to prevent deterioration through decomposition. For manufacture on a moderate scale sun drying can be adopted. The coagulated latex is spread on a glass placed on iron sheets and covered by a glass leaving sufficient room for ventilation. This can easily be powdered in a glass mortar and pestle and after bottling it up it is rendered fit for the market as crude papain. The process can be repeated once in 3 or 4 days till the fruit is covered with incisions 1 cm. apart. Ordinarily 3 to 4 tappings can be done.

As regards yields little information is available. In Ceylon an yield of 175 lb. per acre is regarded as satisfactory, and an average yield can be reckoned to be 100 lb. per acre.

A small curiosity trial conducted by an enthusiastic grower of the area gave 2 lb. of crude papain from six selected trees lancing being done thrice. The cost of labour amounted to Rs. 3 for 12 men engaged for the entire process. The cultivation expense for the six trees is estimated to be Rs. 1—8—0. Thus the cost of production comes to Rs. 2—4—0 per lb. The marketable value of papain is reported to be Rs. 6 per lb. This leaves

a net gain of Rs. 3—12—0 per lb of the product. To this Rs 3 realised by sale of the fruit of these six trees can be added. It was not possible for the writer, with the limited facilities on hand, to investigate in greater detail the true economic picture of the problem. It is now left to the enthusiastic fruit growers of the area to carry it on a wide scale as the profits are apparently attractive to raise their interests and thus give their aid to those unfortunates whose weak digestion cries out for help. A problem that still awaits solution is the absence of a wide market for the lanced fruit as they present an unattractive appearance in contrast with the unlanced fruit, in spite of the quality remaining the same.

Economics of Cultivation. The cost of cultivation (as detailed in appendix) comes to Rs. 150 for the first season (May to December of the following year) and Rs. 110 for the second season (January to January of the next year). Calculating at Rs. 2 per 100 the gross income from an acre will be Rs. 480 in the first season and Rs. 400 in the second season. The net gain will thus be Rs. 330 and Rs. 290 respectively. In the first season an additional net income of Rs. 20 can be realised by way of intercrops. There is a contract system of disposing of the crop in which case the contractor has to pay Rs. 350 to 450 per acre depending on the crop, the charges for watching being borne by the contractor himself.

Conclusion. The highly profitable nature of the cultivation of this fruit crop is widely known among the farmers of the area. There is slow but steady increase in the area under this fruit crop consistent with the demand. Instances are not wanting wherein farmers have cleared off their liabilities and brightened their economic status through the cultivation of this crop. The average holding of an individual farmer is one to two acres and the entire production is in the hands of *Kammas*, an important agricultural community of the tract. A few who have cultivated a taste for the fruit attain self sufficiency by raising it on a small scale in their back yards. The extention of cultivation of this valuable fruit, in the near future, seems to depend upon the demand which the public display towards the fruit and the provision of transport facilities for its export to distant markets outside the production zone.

Acknowledgment. I am deeply indebted to Sri K. C. Naik, B. Ag. (Bom.), M. Sc. (Bristol), Fruit Specialist to the Government of Madras, for his constructive criticism and valuable suggestions.

(APPENDIX)

Cost of Cultivation per acre—details.

First Season (May 1939 to December 1940),

Preparatory cultivation :—	
8 Ploughings @ Rs. 1—4—0 per ploughing	Rs. 10 0 0
Levelling the field	2 0 0
Manures and Manuring :—	
Cattle penning or 15 Cartloads of cattle manure @ 8 as per cartload and application charges ...	10 0 0

700 baskets of cattle manure @ 50 per rupee	14	0	0
Application of manure—16 men	4	0	0
Seeds and Sowing :—			
½ lb. of seed	1	0	0
Cost of raising the nursery to plant an acre	5	8	0
Transplanting—2 men to pull and 12 to plant	3	8	0
Irrigation :—			
8 pot waterings for the young plants—42 women	4	0	0
15 waterings with a mhote @ Rs. 2—8—0	37	8	0
After care :—			
Preparing basin beds round the plants—15 men	3	12	0
Weeding thrice—24 women	4	8	0
Hoeing round the plants twice—30 men	7	8	0
Harvest :—			
Watch for eight months @ Rs. 4 per month, harvest attended by the watchman ...	32	0	0
Assessment of the land	5	0	0
Miscellaneous expenditure	5	12	0
Total cost of cultivation for the season ...	150	0	0
Yield 24,000 fruits valued at Rs. 2 per 100	480	0	0
Net revenue from inter crops	20	0	0
Net gain per acre in the first season	350	0	0

Second Season (January 1941 to January 42).

Manures and manuring :—			
700 baskets of cattle manure @ 50 per rupee	14	0	0
Application of the manure—16 men	4	0	0
Irrigation :—			
15 irrigations with mhote @ Rs. 2—8—0	37	8	0
After care as in the first season	15	12	0
Watch assessment as in the first season	37	0	0
Miscellaneous expenditure	1	12	0
Total cost of cultivation for the second season ...	110	0	0
Yield 20,000 fruits valued at Rs. 2 per 100...	400	0	0
Net gain per acre in the second season...	290	0	0

The need for an intensive Research in the Science of Rural Economy. *

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The word research has long been associated with investigations done in the scientific subjects which are usually studied by most educated men of the country. The scope of research does not end with these subjects, as, in any field of study or activity pursued for the benefit of the people at large, the idea of research still holds good. Compared with physics, chemistry, etc., research in the science of agriculture has been of recent origin. Research has its own reward. Careful observation, analysis of materials and sound enquiries are required to build up the foundation on which the edifice of common good and prosperity have to be built up. One important division of the science of economics, so far as our country is concerned, is the subject of rural economy. The importance of this subject is well known but many have not clearly understood the nature and implications, because it has not been studied exactly in the manner of other sciences. It is seemingly simple but really complex in the interaction of its various aspects and therefore neglected by the intelligentsia of the country In the words of Prof. Radhakumud Mukerjee, "Rural economy being the simplest and oldest form of man's adaptation to environment thus reveals in the sequence of stages certain fundamental types which all go back to the cumulative effects of environment and biological succession. The basic economic adjustments are co-extensive with civilisation. Hence rural economics is an adjunct of the comparative study of civilisation."

The need for research. We know very well how in recent times many towns have newly risen and how others have developed remarkably in the direction of greater wealth and amenities. But our rural areas and villages continue to be in the same old state without any progress in the direction of having modern amenities and improved facilities for making life happy. There has been deplorable stagnation in the life and activity of the rural folk during a period when in other parts of the world there has been remarkable advance in all directions. But rural India is thousands of years old and its economy and problems are of an entirely different nature from what they are in western countries. What has been achieved in those countries in the past few decades, has not been done in ours in the course of ages. The question is whether we shall also advance on the road to modern living and greater prosperity or continue to stagnate as of old. None of us desires the latter alternative. In that case the necessity for the proper understanding of the problems that confront rural folk in their aspirations for better living and more profit from agriculture, becomes apparent and unmistakable.

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* Lecture delivered at Bangalore under the auspices of the South Indian Science Association.

Methods of research. The field of research is very wide and unlike in other science subjects it is not confined to the four walls of the laboratory. One method is by personal enquiry and careful observation. Another is by the issue of suitable and elaborate questionnaire and analysing the answers received from a large number of cases. There may be personal investigations on other lines and problems not covered by the above two.

Differences between tracts and regions. There are very many differences in living conditions, nature and physique of people settled in different tracts. The social customs, time-honoured village practices and many other aspects of communal life are different in different areas. Much of the habits and ways of living of the community are very much affected by the geographical position of the tract and its climatic conditions The dry tracts differ from the wet and the mixed tract differs from both Unhealthy areas like the hills and Agency tracts have their own problems of rural economics and welfare. The peculiar influences that prevail in each such tract have to be studied in detail before attempts can be made to bring about the desirable renaissance

Nature of work already done. Some work has already been done in the various provinces as in the Punjab, Bombay and Madras, in the nature of economic or village surveys. Such enquiries have given only a mass of statistics and have not covered much of the living and social conditions of the community. As a result of those enquiries it has not been possible to formulate proper lines on which action could be definitely taken forthwith to bring an all round improvement in the life, habits and earning capacity of the rural population. A survey of cottage industries and indebtedness of the agriculturist has been made and reported upon but these have been undertaken for the province as a whole and the conclusions and suggestions for improvement are broad and general in character.

Lines of research work to be undertaken 1. *Diet.* Different kinds of grains are consumed in different localities and there is also difference in the way they are taken. The preference for particular grains has been mainly according to availability or the ease with which they can be grown in any area. Detailed investigations have not been systematically done as to why certain classes prefer certain kind and quality of grains and why they take them in a particular way. Work on nutritive values of these grains and various food stuffs has thrown some light on this aspect, but enquiries and investigation on the spot will give more fruitful results. Yellow *cholam* is preferred to white in Coimbatore but white is preferred to yellow in Tinnevelly. *Ragi* is preferred to *cumbu* and sometimes *cumbu* is preferred to *cholam*, as also broken rice to *cholam*. Though fancy plays an important part there may be other reasons for the choice of grain used as staple food. The Village Industries Association has done some work in this line but work applicable to each homogeneous tract has to be undertaken in order to understand the aspect perfectly.

Physique. The generality of men in some regions are robust and wellbuilt whereas in others they do not appear so healthy. Besides the natural conditions of climate, there are other factors as food and occupation which are responsible for the build of body and the inherent strength. Investigations have to be made into this aspect fully so that efforts can be made to improve the diet and living conditions keeping the ideal of a sound mind in a sound body as the goal to be reached.

3. *Production.* The aim should be not only increased production from land but also from other occupations such as the village industries and subsidiary avocations. The Department of Agriculture has been helping to produce more from land, but the economics of production on land and that of the other wealth-giving activities have not been fully studied on a systematic basis. What is required is a concentrated study of each individual area with the factors of production uniform for that area. This helps in understanding clearly the weak points and the defects so that remedies and methods may be suggested for achieving the objects in view.

4. *Feeding stuffs and fodder for cattle.* It is well known that the generality of cattle are undernourished and the undesirables have not been weeded out. The cause is again economic but this could have been overcome to some extent by proper knowledge and adequate help in the improvement of the types of cattle. We have not made intimate studies of the various kinds of seeds and products that go to the manure pit so that we are content with wasting them instead of finding more profitable use as food for cattle. One outstanding example is the use of tobacco seed oil cake which has been experimented upon and found to be good as cattle food. A large quantity of tamarind seed and seeds of various kinds of avenue and forest trees go to waste every season. A concentrated study for each tract for exploitation of such materials would probably yield favourable results for the benefit of the cattle. Work on the nature and use of other types of fodders such as grasses, leaves and fruits of various trees and plants is also required, so that the periods of scarcity of fodder in certain tracts, can be tied over easily. It has been observed that in the western hilly tracts of Madura the cattle are very much resistant to the common diseases that are prevalent among those in other places and that feeding with babool pod powder gives a glistening colour to the skin of the cattle. These serve to show the scope for further extended research and the probability of useful results accruing therefrom

5. *Data for subsidiary occupation.* It is learnt that in Japan more than one third of the rice growing population are rearing silkworms. We are utterly lacking in data for subsidiary occupations particularly with reference to individual regions or districts or in connection with growing of particular crops. We should have full information on the amount of leisure available for the various agricultural communities, i.e., the slack seasons, the aptitude of the people and the facilities that could be given by the State or other agencies and such other details for planning for profitable utilisation

Without these there is no possibility of chalking out popular, workable and profitable lines which could be taken up with avidity by the communities in need of such help.

6. *Efficiency of labour* Due to the pressure of population in many places the efficiency of labour is anything but satisfactory. Data on the movement or seasonal migration of labour and the causes thereof and also on the weekly hours of work extracted by employees in various localities and conditions, is required to assess the degree of efficiency or inefficiency of the labour. The efficiency of the tenant class as agricultural labourers under present conditions is open to question. There is utter lack of the team spirit among many of the cultivating classes and this tells upon their efficiency in production which again affects the total productive capacity of the country.

7. *The Seasonal factor.* Observations and record of the various weather elements in all the places are necessary to give timely forecast of weather conditions for the benefit of every class of the agricultural population as also for those who are affected by changes in weather. The collection of mere rainfall data, though useful, is not enough to plan a method of f recasting by the weather prophet and serve the needs of such a large diversified rural area.

8 *Village industries.* We have no knowledge as to how far foreign goods, machinery and implements have replaced local ones and also their repercussions on the position of village artisans in the socio-economic structure of the village. There is scope for developing small central factories in the important villages for the supply of many articles of common use and spare parts of mplements required by the different classes of the villages. An ambitious programme was drawn up by the village industries association some time back but nothing tangible could be achieved, probably because it attempted to cover a wider area, instead of concentrating in particularly favourable areas.

9. *Rural credit.* Apart from what has been done in this line we do not have data for indebtedness according to villages or group of villages, the various types of credit institutions working in the different rural areas and the percentage of people taking loans from these. The debt per head has to be correlated with the production per acre for every village so as to adjust the starting of the relief-giving agency in order that the place of greatest intensity in indebtedness may get the relief sooner than others not so badly steeped in the evil.

10. *Communications and transport.* The facilities that actually exist in the rural parts for transport of produce and people are to be studied just before initiating improvements. Data for the total mileage of good and bad roads, and the number of miles of new roads essentially to be laid in the different areas, have to be collected. Our rural areas are noted for their lack of good roads, communications and modern transport system. The

present day bus services have no doubt improved the situation, but many villages could not be reached even by these, for want of motorable roads The road transport has a great future in our country because of the obvious huge cost of construction and working of railways The loss sustained per annum by slow movement of produce due to no roads or bad roads, in these progressive days, has not been ascertained. The economics of the use of the rubber tyred cart in the rural areas, have to be studied fully, before recommending these for popular use. There is scope for further improvement of the bullock cart and this line deserves investigation.

Conclusion. There is a vast field of great importance and potentiality waiting to be developed on modern lines and it is on this, the countryside, the future prosperity and the measure of the power of our influence over other countries depend. The Royal Commission on Agriculture concluded, "If the inertia of centuries is to be overcome it is essential that all the resources at the disposal of the State should be brought to bear on the problem of rural uplift. What is required is an organised and sustained effort by all those departments whose activities touch the lives and the surroundings of the rural population." The first effort in this direction would be the organisation of a *Rural Science Research Institute* in every province. This institute will not only undertake the research on the lines mentioned above but also to some extent coordinate the activities of the different departments and bodies engaged in the uplift of the rural population. Compared to what has been done in the United States of America, Russia and other countries where rural areas dominate, the state of affairs in our country can be said to be even primitive Every one should fully realise the implications of the following words of Lord Linlithgow, "India's wealth in an overwhelming degree is in her agriculture and upon the field of the cultivators is founded the whole structure of India's economy."

Thevetia neriifolia Juss.—A New Indigenous Vegetable Insecticide

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Introduction. There is now an urgent necessity for finding out suitable substitutes for the foreign insecticides which are difficult to procure under the prevailing war conditions. Investigations were therefore started at the Agricultural Research Institute, Coimbatore, to determine whether any of the locally available plant poisons could effectively serve as insect killers. A few well-known poisonous plants like *Thevetia neriifolia*, Juss. (roots, stem bark, leaves and kernels), *Nerium odorum* Soland. (root, stem bark and leaves) *Strychnos Nux-vomica* L. (seeds) and *Abrus precatorius* L (seeds) were tested. Of these only the kernels of *Thevetia neriifolia* Juss, were found to possess insecticidal values of a high order.

The plant is originally a native of South America and West Indies. It appears to have been introduced into India in remote times and has since established itself all over the country. It is chiefly grown for ornamental and hedge purposes and is known as *Paccha ganneru* in Telugu and *Ponnarali* in Tamil. Its reputation as a poison is well-known. According to Chopra (1933) the seeds have long been known to be highly poisonous and been commonly used for suicidal and homicidal purposes. Kirtikar and Basu (1933) state that two highly toxic principles—*Thevetin* and *Thevetidine*—have been isolated from the kernels and the bark. The kernels contain about 66 % of oil and according to Watt (1893) the oil is said to be limpid, almost colourless having an agreeable mild taste like that of almond oil.

An attempt is made to present in this paper the results of the preliminary trials carried out with the kernels of *Thevetia neriifolia* Juss. against a wide range of insect pests. The value of the kernels as a powerful contact insecticide is recorded for the first time.

Material and Methods. Ripe and shed fruits were gathered and the fleshy mesocarp removed from them. The seeds were cracked with a mallet and the kernels inside used as the basic material for the toxicity trials. The oil was extracted from the kernels and the insecticidal properties of the oil as well as the cake also were studied. The kernels and the cake were used as infusions and the oil as an emulsion. The former was prepared by mashing and soaking a known quantity of the material in a measured volume of water for a fixed duration. The infusion was then filtered and soft soap equal in weight to that of the kernels or cake used, was then added to the filtrate. The emulsion was prepared by shaking equal quantities of the oil and soft soap in [illegible]d water and then made up to the required strength. The liquid was then sprayed against insect pests and the percentage of mortality recorded. In order to secure uniformity of treatment for all the laboratory trials, the insects concerned were exposed to the spray for 20 seconds at half a foot distance under a pressure of six kilograms per square centimeter.

Laboratory Trials. (a) *Preparation of the extract.* A few trials on the methods of preparing the extract were conducted. These consisted of soaking the mashed kernels in cold water for different durations ranging from six to 24 hours and also by boiling them for five minutes. The infusions, as already mentioned, were filtered and soft soap was then added, as otherwise they were not efficacious. In the absence of soft soap any ordinary washing soap was found to serve the purpose quite well. Biological tests were conducted with the extracts prepared under different conditions and it was found that the one drawn after 24 hours soaking and the one prepared by boiling were equally efficient.

(b) *Dosage.* Infusions in different strengths were tried against various groups of insects to determine the optimum dosage for each group. Soft bodied insects like aphids easily succumbed to a concentration of ¼ ounce of the kernels (0·156%) in a gallon of water, while a high mortality was

noted in the case of caterpillars and beetle grubs with oz concentration (0·312%). Scale insects and mealy bugs however required two to three sprayings with a higher concentration of 1 oz for a gallon of water (0·624%) at intervals of three or four days. The stronger dosage is necessary as the spray has to permeate through the protective covering and kill the adults; the subsequent treatments are for killing the nymphs that may hatch out after the first spray. Infusions of the cake and kernel and emulsion of the oil were tried side by side against *Eupterote mollifera* W. a a uniform strength of ½ ounce per gallon of water and the extract of the kernels was found to be the best of the three.

Field Trials. More extensive biological trials were made on diverse groups of insects with the cold extract of the kernels soaked for 24 hours to which an equal quantity of soft soap was added. The results amply indicate the efficiency of *Thevetia* kernels as a contact insecticide. Its success against *Saissetea nigra* N. and the mealy bugs which are generally difficult to control is very encouraging.

Statement.

No.	Pests concerned.	Quantity of *Thevetia* kernels used per gallon.	Quantity of soap added per gallon.	Average percentage of mortality.	Number of trials.
	I. Rhynchota.				
1.	Saisseta nigra N. (The black scale)	1 oz.	1 oz.	94·5	2
2.	Pseudococcus filamentosus Var. corymbatus Ckll. (mealy bug on cotton)	1 „	1 „	100·0	1
3.	Pulvinaria maxima, Gr. (The nim scale)	1 „	1 „	100·0	1
4.	Aphis malvae K. (plant lice on cucurbits)	¼ „	¼ „	100·0	1
5.	„ taversi D. („ on citrus)	¼ „	¼ „	100·0	4
6.	„ gossypii G. („ „ cotton)	¼ „	¼ „	100·0	3
7.	„ medicagenis K („ on house beans)	¼ „	¼ „	98·5	5
8.	„ nerii B. („ „ calotropis)	¼ „	¼ „	100·0	1
9.	„ maidis F. („ „ cholam)	¼ „	¼ „	100·0	1
10.	Urentius echinus D. (The brinjal lace-wing bug)	¼ „	¼ „	100·0	1
11.	Aleurodes sp. (mealy wings on Phyllanthus sp.)	½ „	½ „	100·0	1
	II. Lepidoptera.				
1.	Eupterote millifera W. (The drumstick hairy caterpillar)	½ „	½ „	98·5	6
2.	Parasa lepida Cr. (The castor slug)	½ „	½ „	70·0	3
3.	Papilio demoleus L (The lemon butterfly)	½ „	½ „	100·0	1
	III. Coleoptera.				
1.	Epilachna 12 punctata M. (the brinjal epilachna beetle)	½ „	½ „	93·0	1
	IV. Hymenoptera.				
1.	Solenopsis geminata F. (The small red ant)	¼ „	¼ „	100·0	1
2.	Camponotus compressus F. (The black ant)	½ „	½ „	100·0	
	V. Acarina.				
1.	Tetranychus telarius L. (The castor mite)	¼ „	¼ „	89·0	

Stomach and Deterrent Effects. There is little or no doubt regarding the fatal action of the kernels when taken internally since one gram of the material caused an immediate collapse, when administered to a dog weighing about 10 lb. Trials were conducted against caterpillars of *Eupterote mollifera* W., *Achoea janata* L., *Parasa lepida* Cr., *Laphygma exiguo* Hb., and grubs of *Epilachna 12 punctata* M.; by spraying the leaves of their respective host plants and allowing the insects to feed on them. All these except *Parasa lepida* Cr., refused to feed for two days and subsequently died of starvation. Hibiscus plants on which blister beetles—*Mylabris pustulata* Th., were feeding were sprayed with ½ oz. concentration of the kernels. No beetles were found on the treated plants on the subsequent days while a number of them were feeding on the unsprayed plants. A ¼ oz. concentration was sprayed on brinjal and citrus plants infested by *Solenopsis geminata* F., and they were not reinfested for a number of days. Though it has not been possible to establish the stomach effect of the kernels from these trials, there is enough evidence to indicate the repellent properties of the infusion.

Effect of the Treatment on the Foliage. It has definitely been found that the maximum dosage of *Thevetia* kernels necessary for the control of insects is one ounce in a gallon of water. Trials were conducted to see whether the infusion at this concentration caused any injury to the foliage of the plants on which it was sprayed. The extract was sprayed on tender as well as mature leaves of mango, sapota, guava, ziziphus, rose, cotton, brinjal, tomato, snake gourd, lablab, etc., and no deleterious effect was noted on the sprayed plants.

Thevetia oil as a Deterrent against Termites. Dealwood plants and pieces of card-board were smeared with *Thevetia* oil and buried under the soil with appropriate controls. Examined after a period of 4 months the controls were found completely eaten away, while the treated samples were only slightly damaged.

Analysis of the Seeds. A large quantity of the seeds was collected on a particular date and stored. Samples were periodically drawn from the stock and subjected to chemical and biological tests to study whether there is any deterioration in the oil contents and toxicity of the kernels. No appreciable variation was noted in the moisture and oil contents by the Government Agricultural Chemist, in his analysis of the samples even after nine months of storage. Biological tests conducted against *Eupterote mollifera* W., and *Aphis malvae* K., with a dosage of ½ oz. and ¼ oz. respectively for a gallon of water also did not show any appreciable variation in the toxicity.

Summary.

1. The utility of *Thevetia neriifolia* kernels as an efficient contact insecticide is established: Aqueous extracts are found highly toxic against a wide range of insects. Optimum strengths for soft and hard bodied insects are indicated.

2. Kernels, cake and oil of *Thevetia neriifolia* Juss. possess toxicity in varying degree ; of these the kernels are the most toxic.

3. Addition of soap equal in quantity to that of the kernels used is necessary to secure the maximum effect

4. Aqueous extracts of the kernel are found, in some cases, to confer immunity from attack by insects for short periods to plants sprayed with them.

5. *Thevetia* oil is found to act as a deterrent against termite attack.

Acknowledgments. Our thanks are due to the Government Agricultural Chemist for having kindly undertaken the analysis of the samples of the kernels.

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Paper Making as a Cottage Industry.

By M. S. VEDAMANI.

Farm Management Course.

The History of paper. In olden days, our anscestors used to write their records and invitations on the leaves of palms like palmyra. As days passed on, the Chinese were the first to prepare paper in cottages Then as we were trading with them some of our people learnt the art from them, but they kept it a secret. After the invasion of the Mahomedans, it was taken to their country, and thus the industry spread over the whole of Europe, but it almost perished in India. Then after centuries, the industry was again brought to India and began flourishing well. But as a result of the industrial revolution the mills came into existence, thereby adversely affecting the cottage Industry

Now again, the industry is being popularised. The All India Village Industries Association is doing its best for the revival of many cottage industries, including that of paper.

Raw materials used in paper making. All fibrous plant material are used in paper making. They can be divided into two main divisions, Soft materials like the rice straw, plantain leaf sheath, waste paper, etc., and hard materials like the jute, sunnhemp, rags, bamboo, etc.

Processes involved in paper making. The raw material has to undergo the following treatments before it is actually made into paper.

Sorting and dusting. Every raw material has to be sorted well and dusted, so that it may be free from foreign matters.

Cutting. The raw material is then cut into small and uniform pieces so that it may be easier to handle them in the several processes of pulp making.

Boiling. The material is then boiled with a small percentage of caustic soda, which greatly helps in the separation of the fibre except in the case of waste paper which is merely soaked in water with a small percentage of caustic soda and allowed to remain soaked for two days.

Washing. Then, the material is given a washing, so as to remove the caustic soda present in it, so that it may not hurt the worker who handles it. This is done by putting the material in a thick cloth and allowing the water to pass through it freely, thereby washing off the caustic soda.

Trampling. After this, the soft materials are put in a hemispherical pit and trampled under foot. This is to continue until the fibres are separated fully well.

Beating. The hard materials are beaten under a simple arrangement called the *Dhenki.* This is based on the pestle and mortar method. This requires two workers, one for operating the *Dhenki* under his feet, and the other for feeding it with the material.

Now the fibres are completely free and the pulp is ready. This pulp is washed again. In some cases, the material requires a second boiling and beating.

Bleaching. Then the pulp is bleached. The pulp is put in a small tube half filled with water and a small percentage of bleaching powder added to it and left undisturbed for about 12 to 15 hours. It is washed again so that it may be free from the alkali present in it.

Lifting and drying. Then the pulp is transferred to a vat, the top of which is bigger than the bottom in perimeter, and filled with water. The pulp is stirred well so that the fibres are free in water. The implements required in the lifting process are, a mat prepared from a kind of grass and horse hair and wooden frame on which the mat is spread. The frame along with the mat is dipped into the vat and lifted up horizontally, thereby forming a thin layer of pulp on the mat. The water is drained off through the space between the grasses of the mat. This thin layer is then transferred to a napkin and kept on the table. Many such napkins are kept one over the other and then pressed with a plank so that the water in them may be completely squeezed out. The napkins are then pasted to the wall the paper coming in between the wall and the napkin. After it is well dried, the napkin and the paper are removed from the wall. Now the paper is ready but as it is, it is only a blotting paper absorbing moisture. So it has to be sized.

Sizing. A paste of rice folour is prepared with the addition of some alum. This is used as the sizing material. This is applied on both sides of the paper and dried. This paste, not only acts as a sizing material, but also strengthens the paper.

Glazing. Last of all, the paper is glazed. This is done by any smooth stone. The glazing gives a very nice finish to the paper.

Now the paper is ready for the market. This industry can easily be organised in a village, with an initial capital of Rs. 150 to Rs. 200.

Advantages of using hand made paper. They are stronger than the mill made paper. By using hand made paper, we get a good market for the raw products produced in our villages. We feed many of our own villagers by using the paper prepared by them.

ABSTRACTS

Experiments on flue-cured tobacco. E. M. Mathews and T. B. Hutcheson (*Virginia Sta. Bul.* 329; 1941).

Flue-cured tobacco thrives on well drained soils of structure and texture which provide good aeration and facilitate ease of cultivation, e. g., Durham, Granville, Norfolk, Appling, and deep phase Cecil sandy loams soils with yellow or light red subsoils with sufficient slope to drain quickly after rains. Rotations favourable to the production of high quality leaf should supply a considerable quantity of organic matter to the soil from nonlegumes but omit legumes. Some good type rotations are tobacco, small grains, and grass hay or weeds: tobacco and small grains followed by rye to be turned under; and tobacco continuously with rye as a winter cover crop to be turned under before tobacco.

Varieties of flue cured tobacco found best are tall growing kinds adapted to harvesting by the priming method, as Yellow Mammoth, White Stem Orinoco, Yellow Pryor, Virginia Bright and Gold Dollar. Plant beds should be 6 ft. wide and of any desired length, steam sterilized or burned, and fertilized with 4—8—3 or similar fertilizer at rates of from 1 to 3 lb. per square yard. For the production of high quality cigarette tobacco plant should be spaced from 20 to 24 in. apart in 4 ft. rows and should be topped to leave from 14 to 20 leaves per plant. Except where a high percentage of plug wrappers is desired. best results have been obtained by pulling leaves as they ripen rather than by harvesting by cutting the plant. The use of oil burners for curing flue cured tobacco has been somewhat more expensive than curing with wood under average Virginia conditions, but temperature may be controlled more easily.

On good tobacco soils under average conditions a fertilizer analyzing N 3 per cent, phosphoric acid 10, and potash 6, at the rate of 1,000 lb. per acre is indicated for satisfactory results. The rate may be lowered to 800 lb. per acre on heavier types of soils or the N percentage reduced. The studies of the nutrient carriers suggest that in compounding tobacco fertilizers, from one-fourth to one-third of the N should be derived from organics, one-third from nitrates and the remainder from standard inorganic sources, the P from superphosphates or other readily available salts and the K from readily available K salts in such proportions as to carry about 2 per cent of chlorine. Fertilizers should not be applied to come in direct contact with the plant roots. This may be accomplished by using a machine designed to place the fertilizer in bands on each side of the row, illustrated by tests in cooperation with F. H. Bateman, or by running a wide single-shovel plow through the fertilizer drilled in the row before listing or bedding the land. N or K in addition to that recommended for use at planting, if needed, should be applied as side dressings at the first or second cultivation. [*Exp. Sta. Rec.* 85, 616, November, 1941].

Zebu (Brahman) cross cattle and their possibilities in North Australia : Co-operative investigations in Queensland, R. B. Kelley (*Austral. Council Sci. and Indus. Res.*

Prog. Rpt., 4, 1940). A report bringing results of crossbreeding of Brahman (Zebu) cattle with domestic beef breeds up to date is presented in continuation of previous investigations noted in part (E. S. R., 78 p. 378). Brahman bulls were mated with cows of the Hereford, Shorthorn, Aberdeen Angus, Red Polled Devon, and Jersey breeds for the production of beef. The color and horn characters were much like the British breeds, including the white face of the Hereford. The breed of Brahman affected the appearance of the hybrid, Guzerat crossbreds being preferred, though not as light in bone as those sired by the Nellore and Gir bulls. Brahman hybrids were more hardy and longer lived than the British pure breds and were found to browse upon trees and shrubs to a much greater extent than the British cattle. The hybrids were also less liable to lose weight in the winter dry season after being held over than the British breeds and showed a much greater tolerance to ticks, which was associated with the percentage of Brahman blood carried. Animals with 75 and 50 per cent of Brahman blood were essentially immune, and those with 37·5 per cent seldom showed tick worry; but the progeny of animals with 19 per cent of Brahman blood showed little more resistance than British bred cattle. Based on a study of a total of 91 Brahman crosses slaughtered from 1938 to 1940, no criticism was found of the quality of the carcasses, and the hybrids graded mostly first on foot and were satisfactorily rounded out. [*Exp. Sta. Rec.* 85, 464, October, 1941.]

Gleanings.

Thermoperiodism. That plants need the daily rise and fall in temperature, as well as the daily changes between daylight and dark, to produce fruits and seeds, have been demonstrated by Professor Fritz Wendt, of the California Institute of Technology. The results of his experiments are expected to be of great value to commercial green housemen and other plant growers, in addition to their significance in the purely scientific study of plant growth and reproduction.

Professor Wendt worked mainly with tomatoes, in a series of air-conditioned greenhouse rooms where temperature as well as hours of exposure to light can be accurately controlled. One set of plants, kept day and night at an unchanging temperature of 26 degrees Centigrade (79 degrees Fahrenheit), supposed to be optimum for plant growth, did grow and blossom, but failed to set fruit. A parallel set of plants, given exactly the same living conditions except that the temperature was dropped about ten degrees Centigrade every night and raised again in the morning set fruit abundantly. These plants also showed better general growth.

In other experiments it was found that even tropical plants, like orchids, respond in the same way to daily fluctuations in temperature.

What the internal physiological changes are that underlie these responses, Professor Wendt is not yet prepared to say. It seems, however, he ventured, that they may have something to do with the formation and translocation of food substances.

Somewhat similar responses to changes in hours of day light, discovered about 20 years ago by Dr. W. W. Garner and H. A. Allard of the U. S. Department of Agriculture, have been given the name "photoperiodism". It would seem appropriate, therefore, to give to the newly discovered temperature phenomenon the analogous name "thermoperiodism". [*Science*, 95, No. 2470, May 1, 1942, Supplement p. 10.]

RELATIVE NUTRITIVE VALUE OF DIFFERENT FORMS OF MILK

By Dr. S. K. KON, National Institute for Research in Dairying, University of Reading.

Composition of different forms of Milk[1]

Form of Milk.	Calories per 100 gm.	Grams per 100 gm.					Vitamin A[2] activity.		Vitamin D[2]		Vitamin B[1]		Riboflavin[3]		Vitamin C.[3]	
		Water.	Protein (N × 6·38)	Fat.	Carbo-hydrate.	Calcium.	I. U. per 100 gms.	Loss in manu-facture.	I. U per 100 gm.	Loss in manu-facture	I. U. per 100 gm.	Loss in manu-facture.	mgm. per 100 gm.	Loss in manu-facture.	mgm. per 100 gm	Loss in manu-facture.
Raw	66	87·6	3·3	3·6	4·7	0·120	70—200	...	0·5—3·0	...	12	...	0·1—0·2	...	0— 2·5	...
Pasteurised	66	87 6	3·3	3·6	4·7	0·120	70—200	None	0·5—3·0	None	11	10%	0·1—0·2	None	0— 2·5	20%
Sterilized	66	87·6	3 3	3·6	4·7	0·120	70—200	None	0·5—3·0	None	8	30%	0 1—0·2	None	0— 1·2	50%
Spray dried whole	512	3·0	25·0	27 5	37·5	0 910	550—1600	None	3·9—23	None	85	10%	0·8—1 6	None	0—16	20%
Roller dried whole	512	3·0	25·0	27·5	37 5	0 910	550—1600	None	3·9—23	None	80	15%	0·8—1·6	None	0—13	30%
Dried skim	357	4·0	36·0	0·5	50·0	1 250	Trace	Most	None	All	115	10%	1·2—2·4	None	0—20	30%
Condensed whole[4] unsweetened	169	68·5	8·4	9·2	12·0	0 300	180—500	None	1·3—7·6	None	18	40%	0·25—0·5	None	0— 2 5	60%
(evaporated)[5]	144	73·0	7·0	8·0	10·0	0·260	150—430	None	1·1—6·5	None	16	40%	0·22—0·44	None	0— 2·2	60%
Condensed whole sweetened	344	25 0	8·8	9·5	53·5	0·325	190—530	None	1·4—8·1	None	29	10%	0·27—0·54	None	0— 5·7	15%

1. The composition varies from sample to sample; the figures given in the table may be taken as representative.
2. Varies according to season.
3. Varies according to the handling of the liquid milk.
4. Product hitherto made in Great Britain in accordance with 1923 Condensed Milk Regulations.

Suggested composition for product manufactured in accordance with the recently reduced standards (Condensed Milk Order, 1940) and corresponding with U. S. A. Standards.

—*Nature*, Vol. 148, No. 3760, Novr. 22, 1941. P. 607—09.

Scientific processing of dried fruits. A scheme for the scientific processing of dried fruits on a large scale has been introduced by the North-West Frontier Province Government following on the Supply Department's decision to obtain all its requirements of dried fruits from the former. The Government of India have agreed to contribute half the capital cost of installing and erecting a plant, subject to a maximum of Rs. 1¼ lakhs.

The plant which is expected to turn out 4,000 tons of dried fruits per year will include several up-to-date forced draft tunnel dehydrators and sulphur houses and a processing and packing plant, besides accommodation and equipment for receiving, preparing and storing the fruits.

The North-West Frontier Province and, to a lesser extent, Baluchistan are the main suppliers of dried fruits required by the Defence Services. In both cases, however, the supplies are largely derived from Afghanistan via tribal territory. Hitherto, the fruits have been mostly sun-dried under indigenous conditions, with the result that rejection on account of dirt and insect infection have been considerable. During recent months, some processing has been undertaken by the N. W. F. P. Government on an existing plant, but the output has been limited owing to insufficient capacity. The present scheme, it is expected, will soon ensure an adequate supply of dried fruits hygienically processed and packed. (*Indian Information* July 15, 1942.)

The chemical composition of pasture as related to animal nutrition. The great majority of the sheep, cattle and horses in New South Wales are maintained throughout the year entirely on pastures and naturally occurring forage. In 1940 the number of these animals in the State was over 57,500,000, and the value of the products obtained from them was roughly £ 49,000,000 even though the year was one of drought in many districts. Our pastures are thus the source of most of the return from livestock and as such are an important raw material and a major national asset, and their feeding value is a very important consideration. (*Agri. Gaz. New South Wales*, May 1942.)

Detecting cow-goat milk mixtures. J. C. Marquardt. (*Jour. Milk Technol.*, 3 (1940) No. 3, p. 144.) The simple test described is based on the fact that goat's milk will give a casein precipitate with ammonium hydroxide at certain temperatures, while cow's milk will not precipitate with like treatment. The addition of as little as 1 per cent of goat's milk to cow's milk can be detected by the test. (*Expt. Sta. Rec* 84,294, 1941.)

Manufacture of veterinary drugs. Arrangements are being made by the Imperial Veterinary Research Institute, Mukteswar, to produce in India veterinary drugs which were previously imported. A considerable number of these drugs can be synthesised or extracted from indigenous plants. To develop this industry, experimental cultivation of medicinal plants on the plains and in the hills and tests on animals may soon be undertaken, according to the Institute's annual report.

A new vaccine against Ranikhet disease which is generally the cause of setbacks in attempts at large scale poultry farming in India, has been produced at the Institute. Tests have proved that the new vaccine is capable of giving good and safe protection. There is still, however, much spadework to be undertaken before its method of preparation and its properties are soundly established. There are now available two vaccines against the disease. It is yet to be decided which of the two is more valuable in practice.

Control of animal diseases. Research on warble fly pest is now nearing completion. Data are available on the respective incidence of parasites in cattle and goats and the ecological conditions which are favourable for its development.

A comprehensive investigation has been started on the influence of climatic factors on animal disease in India. Among other problems under investigation are contagious pleuropneumonia, contagious abortion, acute theileriasis, which is fatal to calves, diseases of goats and the utilisation of the so-called famine fodders.

The role of vitamins in animal nutrition has been studied. Chief interest is centred round vitamin A and its precursor, carotene, insufficiency of which is known to produce serious nutritional disorder common in India. A modified method for the chemical estimation of carotene has been worked out and studies made of the development of carotene in different species of green plants, its distribution within the plant at various stages of growth and its stability under different conditions of storage. Work on the nutrition value of various fodder tree leaves and straw previously treated with alkali is also in progress. (*Indian Information*, June 15, 1942.)

Crop and Trade Reports.

Statistics—Crop—Sugarcane—1942—First report. The average of the areas under sugarcane in the Madras Province during the five years ending 1940—41 has represented 3·0 per cent of the total area under sugarcane in India.

The area under sugarcane up to 25th July 1942 is estimated at 97,860 acres. When compared with the area of 90,720 acres estimated for the corresponding period of last year, it reveals an increase of 7·9 per cent. The estimated area is the same as that of last year in East Godavari, Kistna, North Arcot, Salem and Tinnevelly. An increase in area is revealed in Bellary, Cuddapah, the Carnatic, Chittoor, Coimbatore, Trichinopoly, the South (except Tinnevelly) and the West Coast owing to the high price of jaggery and a decrease in area in Vizagapatam, West Godavari, Guntur, Kurnool and Anantapur. The variations are marked in Vizagapatam (−3,000 acres), South Arcot (+4,000 acres) and Trichinopoly (+3,000 acres). The condition of the crop is satisfactory except in South Arcot where the crop is reported to have been affected by drought to some extent.

The wholesale price of jaggery per imperial maund of 82$\frac{2}{7}$ lb. (equivalent to 3,200 tolas) as reported from important markets on 11th August 1942 was Rs, 13—3—0 in Erode, Rs. 12—2—0 in Mangalore, Rs. 11—14—0 in Salem, Rs. 11—8—0 in Cuddalore, Rs. 11—5—0 in Chittoor, Rs. 11—2—0 in Vellore, Rs. 11—0—0 in Adoni, Rs. 10—12—0 in Coimbatore, Rs. 10—9—0 in Trichinopoly, Rs 9—14—0 in Rajahmundry, Rs. 9—9—0 in Cocanada, Rs 7—12—0 in Vizianagaram, and Rs. 6—11—0 in Bellary. When compared with the prices published in the forecast report issued at this time last year, these prices reveal a rise of approximately 258 per cent in Salem, 221 per cent in Coimbatore, 174 per cent in Chittoor, 171 per cent in Cuddalore, 151 per cent in Vellore, 139 per cent in Rajahmundry, 132 per cent in Cocanada, 125 per cent in Vizianagaram and Trichinopoly, 123 per cent in Adoni, 106 per cent in Bellary and 83 per cent in Mangalore.

Statistics—Crop—Gingelly—1942-43—First forecast report. The average of the areas under gingelly in the Madras Province during the five years ending 1940—41 has represented 16·0 per cent of the total area under gingelly in India. The area under gingelly up to the 25th July 1941 is estimated at 299,600 acres as against 281,800 acres estimated for the corresponding period of last year, an increase of 6·3 per cent. The estimated area is the same as that of last year in Guntur; an increase in area is revealed in West Godavari, the Deccan, the Carnatic and the Central districts (Chittoor excepted), Tanjore, Ramnad and South

Kanara owing to the high price of gingelly during the sowing period and a decrease in area in the other districts owing to want of timely sowing rains. The decrease is marked in Vizagapatam (—17,000 acres)

The crop suffered from drought to some extent in Vizagapatam, North Arcot, Trichinopoly, Ramnad and Tinnevelly. The yield is expected to be generally normal in the other districts.

The wholesale price of gingelly per imperial maund of 82$\frac{2}{7}$ lb. (equivalent to 3,200 tolas) as reported from important markets on 10th August 1942 was Rs. 11—0—0 in Trichinopoly, Rs. 10—8—0 in Tuticorin, Rs. 10—5—0 in Cuddalore, Rs. 9—10—0 in Salem, Rs. 9—0—0 in Cocanada, Rs. 8—13—0 in Rajahmundry, Rs. 8—11—0 in Ellore, Rs. 8—0—0 in Tinnevelly and Rs. 7—12—0 in Vizianagaram. When compared with the prices published in the report for the corresponding period of the previous year, i. e., those which prevailed on 4th August 1941, these prices reveal a rise of approximately 65 per cent in Tuticorin, 60 per cent in Cuddalore, 59 per cent in Salem, 55 per cent in Rajahmundry and Trichinopoly, 40 per cent in Ellore, 29 per cent in Vizianagaram and Cocanada and 19 per cent in Tinnevelly. *(Director of Industries and Commerce, Madras.*

Cotton Raw in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1942 to 31st July 1942 amounted to 442,515 bales of 400 lb. lint as against an estimate of 563,800 bales of the total crop of 1941—42. The receipts in the corresponding period of the previous year were 475,075 bales. 411,603 bales mainly of pressed cotton were received at spinning mills and 2,231 bales were exported by sea while 70,853 bales were imported by sea mainly from Karachi and Bombay.

(Director of Agriculture, Madras).

Moffusil News and Notes.

The Kodur Fruit Growers' Co-operative Society, Ltd., Rajampet. We are informed that the Kodur Fruit Growers' Co-operative Society Ltd., has opened two more orange grading stations, one at Kodur for supplies to the Madura District and the other at Reddipalli (Pullampet P. O.), for the Trichinopoly and Coimbatore Districts. The old station at Rajampet continues to cater for all other places.

Rural Exhibition, Harur. A Rural Exhibition was conducted in Harur from 11—7—42 to 14—7—1942 under the auspices of the Taluk Rural Uplift Committee. The exhibition was opened by the Revenue Divisional Officer, Dharmapuri. The District Collector, Salem, presided on the concluding day. In the agricultural stall, improved seeds, ploughs and models of cattle sheds were exhibited. Vegetables, chillies, tomatoes, brinjals and radish raised from seeds supplied by the Department were also exhibited and these were appreciated very much. A model bee hive with live colony was also put up. (S. D)

College and Estate News.

Students' Corner. The inaugural address of the Students' Club was delivered by Sri M. Bapineedu, B. Sc (Cornell), M. Sc. (California), M. L. A., on the 5th July, with Sri H. Shiva Rao in the chair. The lecturer spoke at length on the importance of agricultural education and pointed out to the students how they should develop a wider outlook.

The budget session of the Club was held on the 17th July 1942 with Sri H. Shiva Rao, the Vice-President, in the chair. Allotments were made for the various activities of the Club. Dailies and periodicals were voted for,

A parliamentary debate was held on the 3rd August on the following proposition: "In the opinion of the house the recent Wardha resolution of the Indian National Congress demanding the British Power to withdraw should not be implemented under the present circumstances." Sri T. Nataraj, B. A., B. Sc. Ag., Assistant Lecturer in Agriculture, acted as the observer. There was a very lively and prolonged discussion at the end of which the motion was voted upon and was lost.

At a meeting of the Students' Club held on the 20th August with Sri H. Shiva Rao in the chair, a condolence resolution on the sudden demise of Sri Mahadev Desai was passed. On the same day at a general body meeting held later, a resolution congratulating S. V. Ramamurti, Esquire, I. C. S., on his appointment as Adviser to His Excellency in place of Sir H. M. Hood who went on leave was adopted.

Consequent on the resignation of Sri C. Srinivasan, of his Secretaryship, Sri T. M. Venkataraman, was unanimously elected as the Secretary of the Students' Club at a meeting held on the 17th August, with Sri H. Shiva Rao in the chair. Sri Ayyannaji Rao was unanimously elected as the representative of the First Year class.

Games. *Hockey.* The opening match was played on the 9th July against the Officers XI and we won by 6 goals to 2. The second match was played on the 25th against the Central Recruit School, Coimbatore, on their grounds, and our college won by 6 goals to 1. Two more matches were played against the Officers XI, one on the 28th and the other on the 30th July, resulting in a defeat for Officers XI by 5 goals in the former case and for the students XI by 2 goals in the latter.

Football. The opening match was played against the Government Arts College, Coimbatore on the 23rd August and we were defeated by 2 goals to 1.

Demonstrators' Conference. A half yearly Conference of the Coimbatore *cum* Nilgiris District work of the Officers of the Agricultural Department was held at the Agricultural College, Coimbatore from 17th to the 22nd August,

Visitors. P. H. Rama Reddy Esquire, Director of Agriculture, R. W. Littlewood Esquire, Livestock Development Officer, Sri P. Abishekanatham, Curator, Government Botanical Gardens and District Agricultural Officer, Nilgiris and Sri H. Narahari Rao, Manager, Poultry Research Farm, Madras, and the Agricultural Demonstrators of the Coimbatore and Nilgiris Districts were among the visitors to the Agricultural College and Research Institute during the month.

Departmental Notifications.

Gazetted Service.

Postings.

Sri R. Chokkalingam Pillai, D. A. O. (on leave) to be D. A. O. Tanjore.

Sri K. Raghava Acharya, J. L. A. and Asst. Supdt., Central Farm, Coimbatore to be D. A. O. Kurnool.

Sri K. K. Raghavan, D. A. O. Tanjore to be D. A. O. Tinnevelly.

Subordinate Service.

Promotions

The following promotions in the Madras Agricultural Subordinate Service, Lower Subordinates, are ordered with effect from the 1st August 1942:-

From III Grade to II Grade

Sri K. Achuthan Nambiyar, Asst. A. D. in Mycology, Calicut.

" L. K. Narayana Ayyar, Asst. A. D, Tiruthuraipundi.

From IV Grade to III Grade

Sri M. Krishnaswami Ayyangar, Asst A. D. Dharmavaram.
,, P M. Appasamy Pillai, Asst. A.D. Omalur.
,, M. S. Poornalingam Pillai Sub-Asst. in Cotton, Coimbatore

From V Grade to IV Grade.

Sri M. V. Kondal Rao, Asst. A. D. Sompeta.
,, K. V. Seshagiri Rao, Asst. A D. Hindupur.
,, P Nagadhara Nayudu, Asst. F M. Nandyal.
,, G K. Subrahmanya Ayyar Asst. A. D Arni.
,, R Subrahmanya Ayyar, Asst. A. D. Arantangi.
,, P. Satyanarayana, Asst A. D. Markapur.
,, U. L. Srinivasa Rao, Asst. A. D. Dharmapuri.
,, S. Rajaratna Mudaliar, Asst. A. D. in Mycology, Coimbatore.

Transfers

Name of officers	From	To
Sri M. L. Balasundaram,	Asst. in Paddy A. R. S. Maruteru,	Asst. in charge Rice Res. Station, Buchireddipalem.
,, G. Venkata Sastry,	F. M. Samalkota,	Asst. in Paddy, A. R. S. Maruteru.
,, M. V. Narasimha Sastry,	Asst. A. D, Chodavaram,	F. M. A. R. S. Samalkota.
,, B. N. Padmanaba Ayyar,	A. D (on leave)	F. M. A. R. S. Siruguppa.

Leave.

Name of officers.	Period of leave,
Sri C. V. Sankaranarayana Ayyar, Sub Asst. in Paddy, Coimbatore.	L. a. p. for 1 month from 17—8—42.
,, S. Varadarajulu Naidu, A. D. Dhone,	L, a. p. on m. c. for 1 month from 17—8—42.
,, N. Annaswami Iyer, A. D, Giddalur	L. a. p. for 1 month from 22—7—42.
,, E. J. Verghese, Asst, in Chemistry. Coimbatore.	L. a. p. for 1 month from 23-7-42.
,, K. Ramaswami, Asst. in Paddy, Coimbatore,	L. a. p. for 1 month from 23-7-42.
,, R. Krishnamurthi, A. D. Chengam,	Extension of l. a. p. on m. c. for 3 months from 3-8-42.
,, P. Kesavanunni Nambiar, F. M, A. R. S., Taliparamba,	L. a. p. on m. c. for 2 months from 15-7-42.
,, S. Krishna Nayak A. D. Kasaragod,	L. a. p. for 1 month from 8-8-42.
,, P. S. Narayanaswami, Entomology Asst. Coimbatore,	L. a. p. on m. c. for 2 months from 4—8—42.
,, K. Brahmachari, Entomology Asst. I. C. A. R. Sugarcane pest scheme, Nellikuppam,	L. a. p. on m. c. for 2 months from 4-8-42.
,, M. Narasimham, A. D., Tenali,	Extension of l. a. p. on m. c. for 1 month from 1-8-42.
,, G. Doraiswami, A. D. Koilpatti,	Earned leave with pay for 31 days from 10-8-42.

„ V. Chidambaram Pillai, A. D. Sankarankoil,	L a p. for 1 month from 12-8-42.
„ P. Sitharamayya, Botany Asst., A. R. S. Anakapalli,	Earned leave with pay for 31 days from 13-8-42.
„ N. Raghava Rao, Asst. to the Govt. Entomologist, Vizagapatam,	Earned leave with pay for 1 month from 17-8-42.
„ V. Tirumala Rao, Entomology and Mycology Asst., Samalkot,	L. a. p for 1 month on m. c. from 3-8-42.
„ K. Balaji Rao, A. D. Adoni,	Extension of l. a. p. on m. c, for 1 month from 11-7-42